TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
1.1	Purpose of Study	1
1.2	Authority and Acknowledgments	1
1.3	Coordination	1
2.0	AREA STUDIED	2
2.1	Scope of Study	2
2.2	Community Description	2
2.3	Principal Flood Problems	4
2.4	Flood Protection Measures	4
3.0	ENGINEERING METHODS	4
3.1	Hydrologic Analyses	5
3.2	Hydraulic Analyses	6
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	7
4.1	Flood Boundaries	7
4.2	Floodways	7
5.0	INSURANCE APPLICATION	10
5.1	Reach Determinations	10
5.2	Flood Hazard Factors	10
5.3	Flood Insurance Zones	10
5.4	Flood Insurance Rate Map Description	11

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TABLE OF CONTENTS (Continued)

		Page
6.0	OTHER STUDIES	11
7.0	LOCATION OF DATA	13
8.0	REFERENCES AND BIBLIOGRAPHY	13

FIGURES

Figure	1	-	Vicinity Map	3
Figure	2	-	Floodway Schematic	8

TABLES

Table	1	-	Summary of Discharges	5
Table	2	-	Floodway Data	9
Table	3	-	Flood Insurance Zone Data	12

EXHIBITS

Flood Profiles

Lac Qui Parle	Panel	01P
Minnesota River	Panel	01P
Marsh Lake	Panel	01P
Pomme de Terre River	Panels	02P - 03P

Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

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FLOOD INSURANCE STUDY

SWIFT COUNTY,
UNINCORPORATED AREAS,
MINNESOTA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Unincorporated Areas of Swift County, Minnesota, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for the Minnesota River were performed by the U.S. Army Corps of Engineers (COE) (the Study Contractor) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-E-0941, Project Order No. 11. This study was completed in May 1984.

The hydrologic and hydraulic analyses for the Pomme de Terre River were taken from the City of Appleton, Swift County, Minnesota Flood Insurance Study (Reference 1).

1.3 Coordination

Streams requiring detailed study were identified by representatives of the Study Contractor and FEMA during an August 16, 1982, telephone conversation. At a subsequent December 14, 1982, meeting held in Montevideo, Minnesota, the study limits were agreed upon by representatives of the Study Contractor, FEMA, the Minnesota Department of Natural Resources (MDNR), and Swift County.

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On January 8, 1985, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Swift County, Minnesota. The area of study is shown on the Vicinity Map (Figure 1). The incorporated areas within the county were excluded from this study.

The flooding sources studied in detail in Swift County were the Minnesota River and the Pomme de Terre River.

The Minnesota River has been divided into three distinct hydraulic reaches: Lac Qui Parle, the Minnesota River, and Marsh Lake. Lac Qui Parle, a Minnesota River impoundment, was studied in detail from the downstream county boundary to about 1,700 feet downstream of the State Highway 119 bridge. Flooding on the Minnesota River was studied in detail from about 1,700 feet downstream of the State Highway 119 bridge to Marsh Lake Dam. Marsh Lake, a Minnesota River impoundment, was studied in detail from the dam to the Big Stone County boundary.

The Pomme de Terre River was studied in detail from about 2.2 miles downstream of the Chicago, Milwaukee, St. Paul & Pacific Railroad to about 2.4 miles upstream of the Burlington Northern railroad.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards.

The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through May 1989. The scope and methods of study were proposed to and agreed upon by FEMA and Swift County.

2.2 Community Description

Swift County, with an area of approximately 748 square miles, is located in western Minnesota about 120 miles west of Minneapolis and about 55 miles southwest of St. Cloud, Minnesota. Swift County is bordered on the north by Stevens and Pope Counties, on the east by Kandiyohi County, on the south by Chippewa County, on the west by Big Stone County, and on the southwest by Lac Qui Parle County. The Minnesota River system forms the extreme southwestern boundary of the county. The 1970 population of 13,177 decreased to 12,900 in 1980 (Reference 2). About 87.2 percent of the county land is devoted to agriculture (Reference 3).

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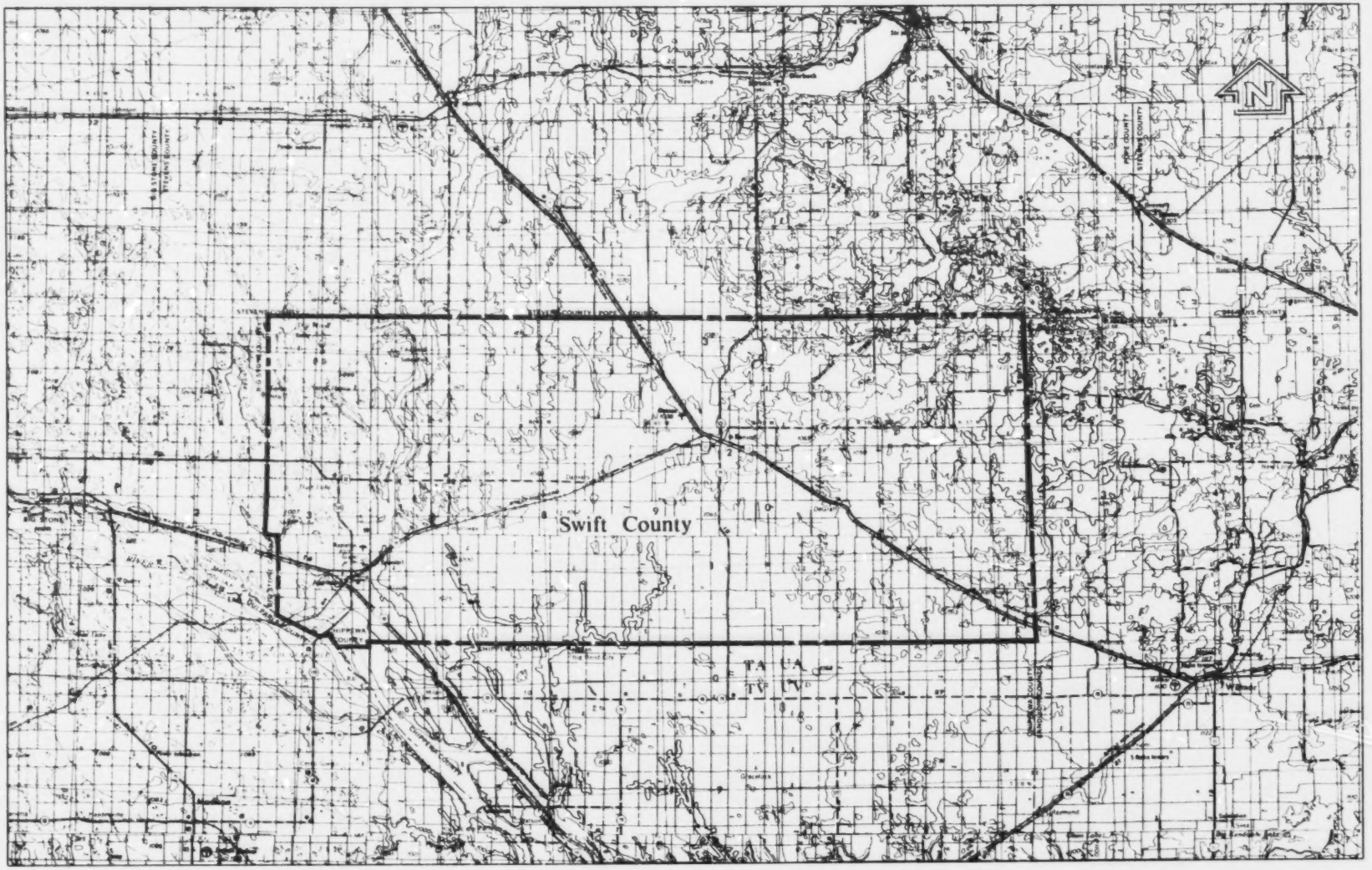

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

SWIFT COUNTY, MN
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

8 0 8 16 24MILES

VICINITY MAP

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Swift County is covered by glacial drift from the late Wisconsin Glaciation. The mantle of drift ranges from 150 feet thick in the southwestern part of the county to 300 feet in the northeastern part. The till was deposited mainly in the northern part of the county and then washed by overland flow of water to the central and southern portions of the county. The northern part of the county consists of undulating to rolling hills while the central and southern portions of the county are nearly level. The drainage of Swift County is entirely into the Minnesota River through the Pomme de Terre River basin in the western half of the county and the Chippewa River basin in the eastern half of the county (Reference 4).

The drainage area at the U.S. Geological Survey (USGS) gaging station downstream of the Lac Qui Parle outlet (about 16 miles downstream of the Swift County line) is 4,050 square miles (Reference 5).

Swift County has a continental climate with warm summers and cold winters. The average monthly temperatures vary from 11.4 degrees Fahrenheit (F.) in January to 72.0 degrees F. in July. The average annual temperature is 43 degrees F. Annual precipitation averages about 24 inches (Reference 6).

2.3 Principal Flood Problems

Low-lying areas adjacent to Marsh Lake, Lac Qui Parle, and the Minnesota River are subject to periodic flooding. The most severe flooding occurs in early spring as a result of heavy rain and snowmelt. The flood of record occurred in April 1969 (Reference 5). The April 1969 flood is considered approximately equivalent to the 100-year flood data developed for this Flood Insurance Study.

2.4 Flood Protection Measures

There are no flood protection measures within the detailed study area. Marsh Lake Dam provides little or no flood storage capacity and is not operated as a flood control project. No Federal flood control projects are proposed within the foreseeable future.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or

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exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

The Minnesota River, which flows through the southwestern corner of Swift County, has been divided into the following three distinct study reaches for this study, based on hydraulic characteristics: Lac Qui Parle, the Minnesota River, and Marsh Lake. Development of elevation-frequency data for the river system was based on stage data recorded at the Marsh Lake Dam (Reference 7) for the 41-year period of record. To ensure coordination with the Chippewa County Flood Insurance Study discharges (Reference 8), the 41 years of record were adjusted to the longer period of record (70 years) at Montevideo, Chippewa County, Minnesota, by using the median (Beard's) plotting points (Reference 9) of the Montevideo record. The plotting point data were used to draw graphically the frequency curve for the Marsh Lake Dam.

A discharge-frequency relationship for the Pomme de Terre River was prepared by the USGS and published in "Techniques for Estimating Magnitude and Frequency of Floods in Minnesota" (Reference 10). The USGS computations utilized a log-Pearson Type III analysis of 40 years of gage data, as outlined in U.S. Water Resources Council (WRC) Bulletin No. 15 (Reference 11). A second log-Pearson Type III analysis of 48 years of gage data was performed by the Study Contractor using the WRC Bulletin 17A (Reference 12) frequency analysis.

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
MINNESOTA RIVER at Marsh Lake Dam	2,800	3,300	7,250	11,700	17,500
POMME DE TERRE RIVER at Appleton	907	2,620	5,300	6,700	11,000

The discharge values have been coordinated with the Minnesota USGS, the Minnesota Soil Conservation Service, and the MDNR.

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3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals.

Water-surface elevations for floods of the selected recurrence intervals were computed for Lac Qui Parle and Marsh Lake. Hydraulic computer models were not developed for Lac Qui Parle and Marsh Lake. The water-surface elevations are based on rating curves and historic flood profiles (Reference 7).

Minnesota River flood profiles were computed using the COE HEC-2 step-backwater computer program (Reference 13). Starting water-surface elevations were developed from Lac Qui Parle rating curves and historic flood profiles (Reference 7). The HEC-2 computer model was calibrated to the 1969 flood event.

Cross sections for the hydraulic analysis of the Minnesota River were obtained by field measurement. All bridges, dams, and culverts were field surveyed to obtain elevation and structural geometry (Reference 14).

Water-surface elevations for the Pomme de Terre River were computed through the use of the COE HEC-2 step-backwater computer program (Reference 13). Starting water-surface elevations for the Pomme de Terre River were developed using the slope-area method.

Cross sections for backwater analysis of the Pomme de Terre River were obtained from the hydraulic analyses conducted by the MDNR for the Flood Plain Information Study for the City of Appleton (Reference 15).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map.

Roughness factors (Manning's "n") used in the Minnesota River hydraulic computations were chosen by engineering judgment and based on field observations of the streams in the flood plain areas. The roughness value selected for the main channel of the Minnesota River was 0.035; the flood plain roughness value selected was 0.110. For the Pomme de Terre River, roughness values varied from 0.035 to 0.045 for the main channel and from 0.06 to 0.12 for the overbanks.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.

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The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations shown on the profiles are, thus, considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929. Elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24000 and contour interval of 10 feet (Reference 16).

For the streams studied by approximate methods, only the 100-year flood plain boundary was delineated using soil survey maps (Reference 17).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map. In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces the flood-carrying capacity, increases the flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot,

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provided that hazardous velocities are not produced. In Minnesota, however, flood plain encroachment is limited by Minnesota Regulations to that which would cause a 0.5-foot increase in flood heights above pre-floodway conditions at any point (Reference 18). Floodways having no more than a 0.5-foot surcharge were delineated for this study.

The Minnesota River floodway presented in this study is based on the effective flow area; therefore, there is a 0.0-foot stage increase. The results of the computations were tabulated at selected cross sections for each stream segment for which a floodway was computed and are presented in Table 2, Floodway Data.

No floodways were computed for Marsh Lake and Lac Qui Parle because floodways are not applicable to areas of lacustrine flooding.

As shown on the Flood Boundary and Floodway Map, the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway of the Minnesota River lie outside the county boundary.

The area between the floodway and the 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.5 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

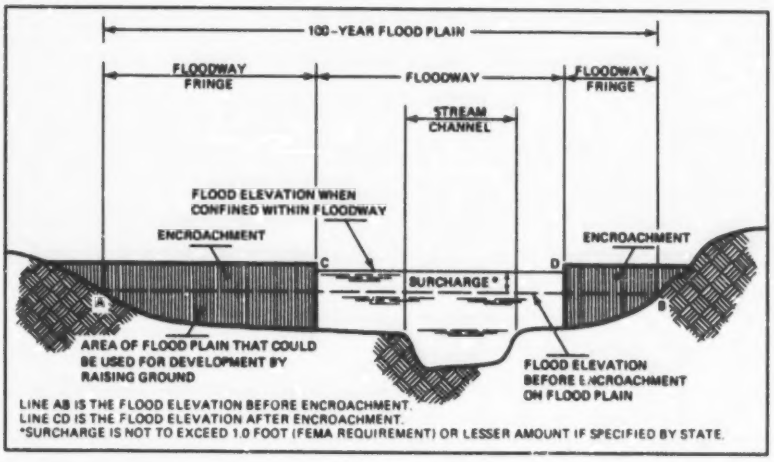
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET[1])	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
MINNESOTA RIVER								
A	5000	2545[3]	24,190	0.5	943.3	943.3	943.3	0.0
B	6680	1001[3]	3200	3.7	943.3	943.3	943.3	0.0
C	6860	1217[3]	11,450	1.0	943.8	943.8	943.8	0.0
D	9220	3572[3]	32,400	0.4	943.9	943.9	943.9	0.0
E	11,750	4523[3]	42,000	0.3	944.0	944.0	944.0	0.0
F	14,080	5470[3]	44,330	0.3	944.0	944.0	944.0	0.0
G	17,900	5139[3]	4830	2.4	944.0	944.0	944.0	0.0
H	19,500	267[3]	3949	3.0	944.2	944.2	944.2	0.0
POMME DE TERRE RIVER								
A	0[2]	389	1506	4.4	971.7	971.7	971.7	0.0
B	20,583[2]	1398	6349	1.1	999.1	999.1	999.2	0.1
C	24,833[2]	629	2948	2.3	1000.1	1000.1	1000.2	0.1
D	27,433[2]	531	2342	2.9	1002.3	1002.3	1002.3	0.0

[1]FEET ABOVE COUNTY BOUNDARY
[2]FEET ABOVE LIMIT OF DETAILED STUDY (LIMITED OF DETAILED STUDY IS 2.23 MILES DOWNSTREAM OF CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC RAILROAD)
[3]THIS WIDTH EXTENDS BEYOND COUNTY BOUNDARY

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

SWIFT COUNTY, MN
(UNINCORPORATED AREAS)

FLOODWAY DATA

MINNESOTA RIVER--POMME DE TERRE RIVER

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5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting Swift County.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the weighted average difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the riverine flooding sources of Swift County are shown on the Flood Profiles and are summarized in Table 3, Flood Insurance Zone Data.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a riverine reach is the weighted average difference between the 10- and 100-year flood water-surface elevations rounded to the nearest 0.5 foot, multiplied by 10, and shown as a 3-digit code. For example, if the difference between elevations is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

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Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.
Zones A5, A6, A8, and A9:	Special Flood Hazard Areas inundated by the 100-year flood, with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- and 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and, areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding source studied in detail in the community are shown in Table 3, Flood Insurance Zone Data.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Swift County is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines for riverine flooding sources show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

Flood Insurance Studies are currently being prepared for the Unincorporated Areas of Chippewa County and Big Stone County (References 8 and 19). The Chippewa County Flood Insurance Study matches this study. Work on the Big Stone County Flood Insurance Study has not progressed to where a comparison can be made. A Flood Insurance Study has been published for the Unincorporated Areas of Lac Qui Parle County (Reference 20). Due to its more detailed analysis, this Flood Insurance Study does not match the Lac Qui Parle County Flood Insurance Study. A Flood Insurance Study has been published for the City of Appleton (Reference 1) and agrees with the Swift County Flood Insurance Study.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (FEET NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
LAC QUI PARLE							
REACH 1	0115	−2.5	−0.4	1.8	025	A5	VARIES—SEE MAP
MINNESOTA RIVER							
REACH 1	0115	−3.0	−0.8	2.1	030	A6	VARIES—SEE MAP
MARSH LAKE							
REACH 1	0115	−3.9	−1.6	2.7	040	A8	VARIES—SEE MAP
POMME DE TERRE RIVER							
REACH 1	0115	−4.4	−1.3	2.6	045	A9	VARIES—SEE MAP
REACH 2	0115,0125	−2.8	−0.8	1.5	030	A6	VARIES—SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

SWIFT COUNTY, MN

(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

LAC QUI PARLE—MINNESOTA RIVER—MARSH LAKE—POMME DE TERRE RIVER

Due to its more detailed analysis, this Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map for Swift County (Reference 17).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, 300 South Wacker Drive, Chicago, Illinois 60606.

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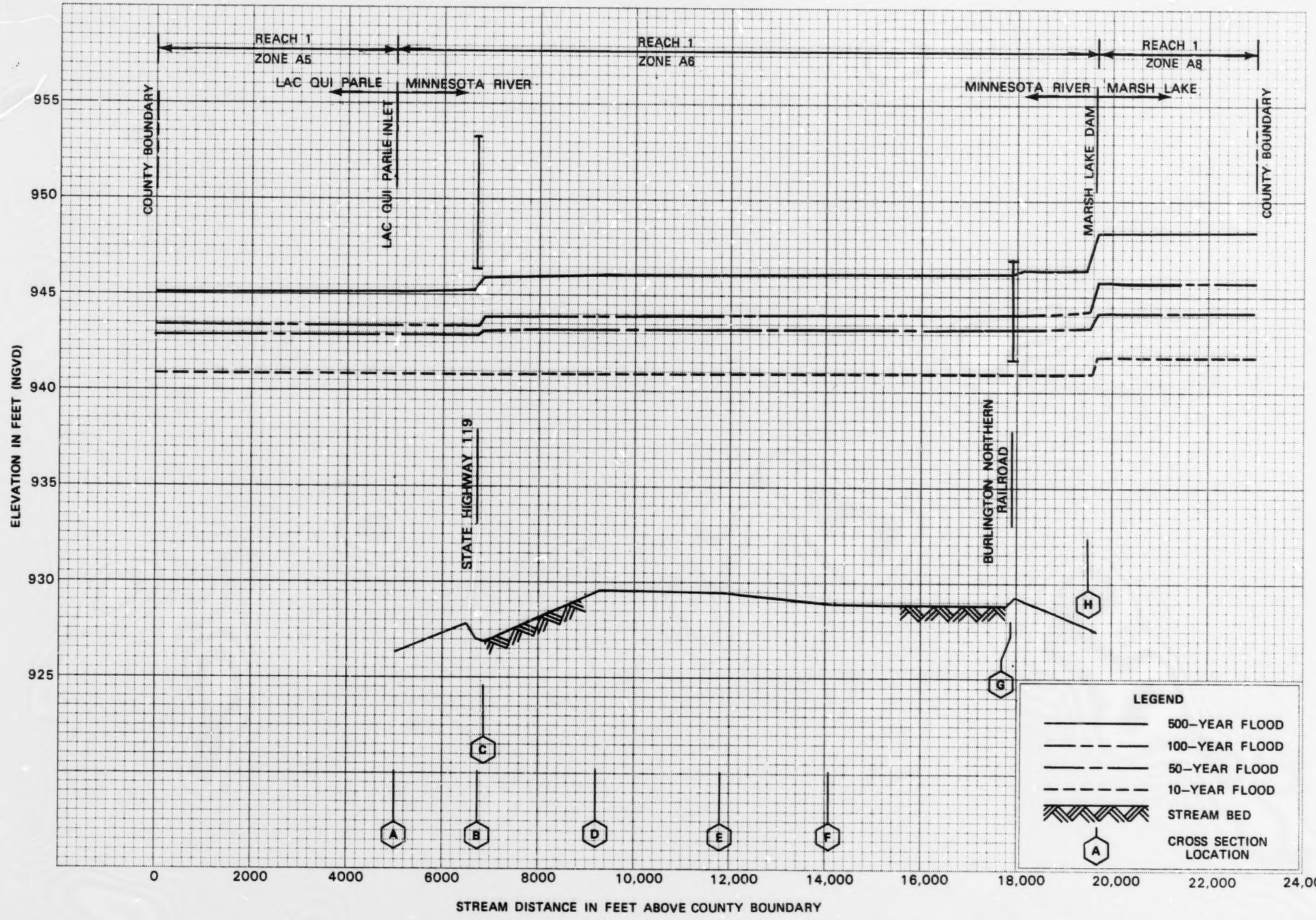

FLOOD PROFILES

LAC QUI PARLE–MINNESOTA RIVER–MARSH LAKE

FEDERAL EMERGENCY MANAGEMENT AGENCY

SWIFT COUNTY, MN
(UNINCORPORATED AREAS)

01P

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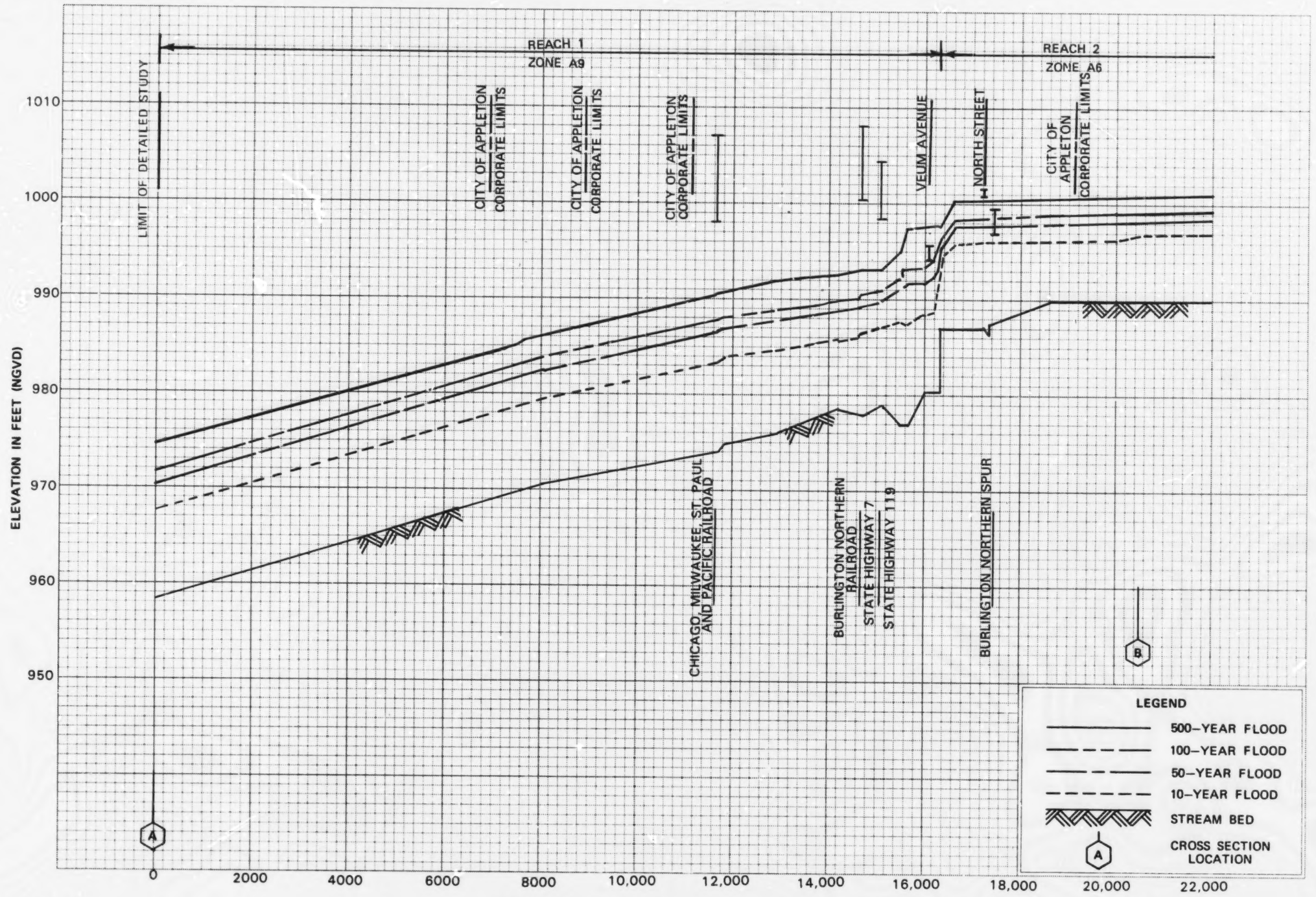

STREAM DISTANCE IN FEET ABOVE LIMIT OF DETAILED STUDY
(LIMIT OF DETAILED STUDY IS 2.23 MILES DOWNSTREAM FROM THE CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC RAILROAD)

FLOOD PROFILES

POMME DE TERRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SWIFT COUNTY, MN
(UNINCORPORATED AREAS)

02P

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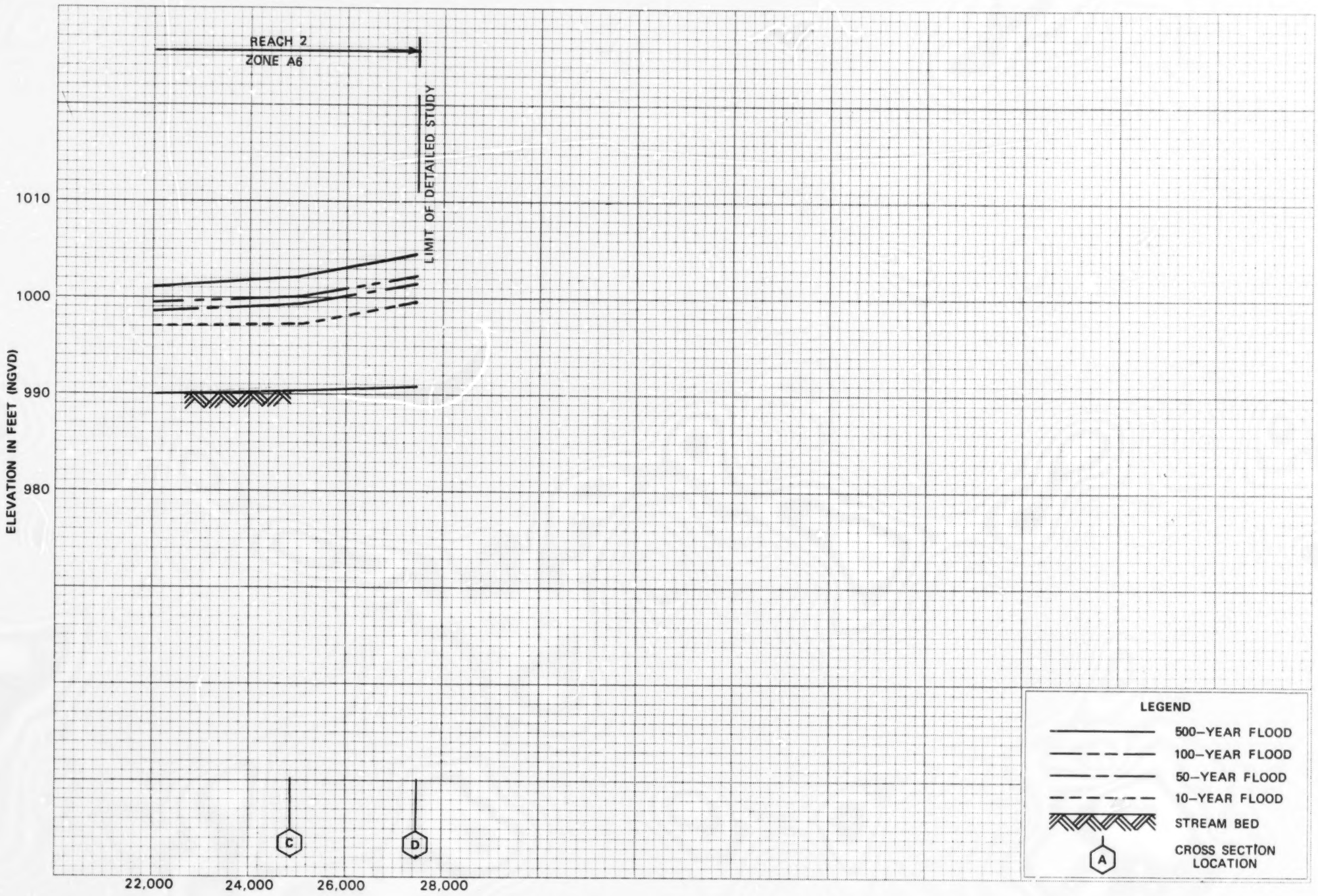

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